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Methodologies applied to the CEIP GNFR gap-filling 2018

Part II: Heavy Metals (Pb, Cd, Hg) of the year 2016

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Melanie Tista, Robert Wankmueller, Katarina Mareckova

Project management

Katarina Mareckova

Authors

Melanie Tista

Robert Wankmueller

Katarina Mareckova

Layout and typesetting

Melanie Tista

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1. Introduction

The EMEP Centre on Emission Inventories and Projections (CEIP) operates the UNECE/EMEP emission database (WebDab) which contains information on air pollutant emissions and projections from the Parties to the LRTAP Convention (UNECE 1979). Among these data sets, also emissions used in EMEP models (gap-filled emissions) and gridded emissions in Google maps are available from the CEIP website (www.ceip.at, CEIP 2018).

Data used by CEIP were reported by the Parties to the LRTAP Convention as sectoral emissions (NFR14) and National Total emissions according to the UNECE guidelines for reporting emissions and projections data under the Convention on long-range transboundary air pollution, Annex I (UNECE 2014). For the use by CEIP, the sector data were aggregated to 13 GNFR sectors. In several cases, no data were submitted by the countries, or the reporting is not complete or contains errors. Before these emission data can be used by modelers, missing or erroneous information have to be filled in. To gap-fill those missing data, CEIP typically applies different gap-filling methods. After the gap-filling, sector emissions are used for spatial emission mapping, i.e. the EMEP grid.

This documentation describes the gap-filling methods that have been used for the 2016 GNFR inventory (as reported in 2018) for lead, cadmium and mercury. It illustrates reasons of replacements of reported data, discusses problems of the procedure and gives an overview on the data availability and gap-filling of each country or area.

2. Summary of the process

The first step is to collect the official submissions by the Parties to the LRTAP Convention. All submissions received up to 27th April 2018 were used as a basis for the gap-filled data set. Parties report their emission inventories to the LRTAP Convention as sectoral emissions (NFR14) and National Total emissions according to the UNECE guidelines for reporting emissions and projections data under the LRTAP Convention, Annex I (UNECE 2014).

The second step is to aggregate the sector data to 13 GNFR sectors. The third step is plausibility checks of all reported data. If plausibility was not given, reported data were replaced (see section 0). The checks comprise:

- Comparison of the reported data with previously reported data, gap-filled data from 2017, and expert data from TNO (Denier van der Gon et al. 2005), the Global Mercury Assessment (AMAP/UNEP 2013, UNEP 2013) and MSC-E (MSC-E 2013).
- Comparisons of the ratio of the reported data to population data and to GDP data with all other Parties. Especially population data, correlate highly with heavy metal emissions (CEIP 2017).
- Comparison of the reported sectoral distribution among the Parties.
- Comparison of the reported sectoral distribution with previously reported data of the respective country and with the mean sector distribution from the 2017 gap-filled data set of all countries.
- Comparison of the sum of sectors with the National Total.

The next step is the gap-filling or change of the inventory. Gap-filling or replacement of data is applied if

(1) no data are submitted by a Party,
(2) the reporting is not complete,
(3) the data are erroneous,
(4) there is no reporting obligation for a certain area and thus no reported data are available.

After that step, the inventory is completed and will be used for the WebDab database (data as used in EMEP models) and for spatial emission mapping, i.e. the EMEP grid.

3. Gap-filling methods

3.1. Gap-filling of National Total data

If no submission is made, first data of previous submissions are checked for plausibility. If previous reported data are plausible and complete, extrapolation of these data is done. This can be done either by extrapolation of sector data and the National Total is then calculated by the sum of the sectors, or by extrapolation of the National Total, and the sector data are then splitted up using a distribution of another year or country.

If no previous reported data are available or the data are not plausible, different estimates were made. These estimates comprise extrapolation of (previous reported or expert) data by using population or GDP data ([1]) of the respective country. Further, (inter-, extrapolation or copy from previous years of) expert data were used.

Available data for comparison are:

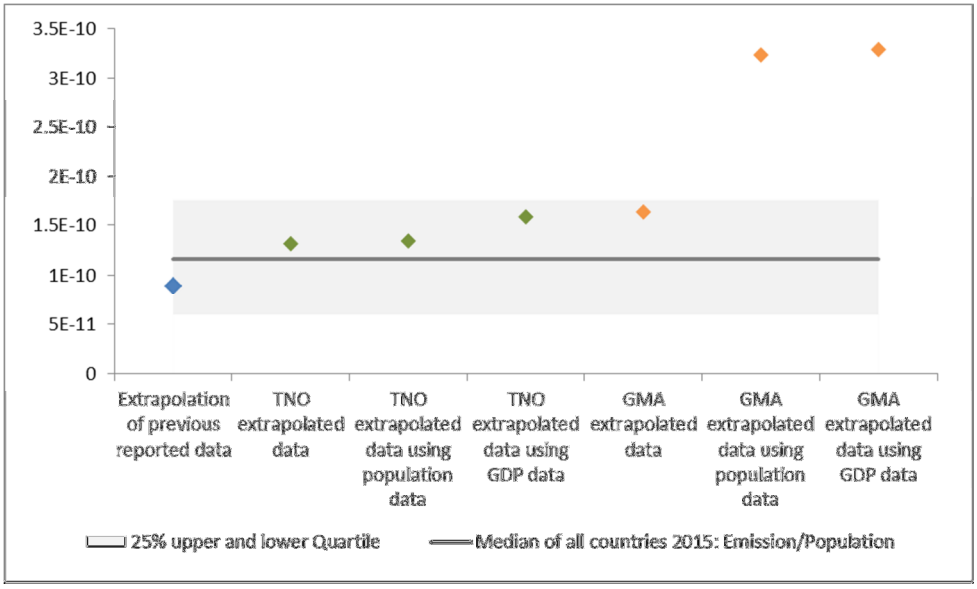
- The most important sources of expert estimates were data from the dutch institute TNO (Denier van der Gon et al. 2005). The study was published in 2005 and comprises emission data of lead, cadmium and mercury for the year 2000 and projections for lead, cadmium and mercury for the year 2010 and for lead for the year 2020.
- Another source of emission data were estimates from the Global Mercury Assessment (AMAP/UNEP 2013, UNEP 2013). Estimates were made for mercury emissions of the year 2010.
- Additionally, expert estimates were provided by MSC-E (MSC-E 2013). These estimates comprise data of the year 2011 for Kyrgyzstan, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, as well as for the Asian Areas and North Africa.

In several cases, not only one estimate is given for a country. To facilitate the choice of the estimate for the gap-filling, ratios for each pollutant between emissions and population data and GDP were calculated by using data of the gap-filled inventory from 2017 (separate for EMEP West and EMEP East countries, for the country grouping see Table 8.1) for the year 2015. The distance of the

([1]) Population data from database: Population estimates and projections (Last Updated: 12/18/2017). Indicator: Population, total. Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates.
GDP data from database: World Development Indicators (Last Updated: 03/01/2018). Indicator: GDP, PPP (constant 2011 international $).

different estimates to this ratio shows how similar the estimates are to the mean. An example for mercury estimates of Kyrgyzstan (KG) is shown in Figure 3.1.

Figure 3.1 Example for different lead estimates for Kyrgyzstan



3.2. Gap-filling of sectoral data

There were no expert estimates on the sectoral distribution of the emissions available, only sector distributions from previous reported submissions and a mean sector distribution from the 2017 gap-filled data set of all countries.

The most common imputation method to gap-fill sector data was to use the distribution ratio of sector emissions from similar countries. To identify which countries are similar to each other, for all countries where data were available ([2]) a distance matrix using Euclidean distances was generated using GDP data ([3]) and gap-filled or reported National Total emissions from cadmium, mercury and lead as variables (z-transformed). For the Asian Areas and North Africa, this analysis was not possible. Therefore, the mean sector distribution from the 2017 gap-filled data set of all countries was used to split the sectors.

For the Russian Federation in the extended EMEP domain (RUE) a similar sector distribution as for the Russian Federation (RU) was assumed.

([2]) This means all countries addressed in this report except AST (Asian Areas), LI (Liechtenstein), MC (Monaco), NOA (North Africa), RUE (Russian Federation in the extended EMEP domain) and RU (Russian Federation in the former official EMEP domain).
([3]) Data from database: World Development Indicators. Indicator name: GDP, PPP (constant 2011 international $), indicator code: NY.GDP.MKTP.PP.KD. Values for 2016 are taken.

3.3. Gap-filling effects

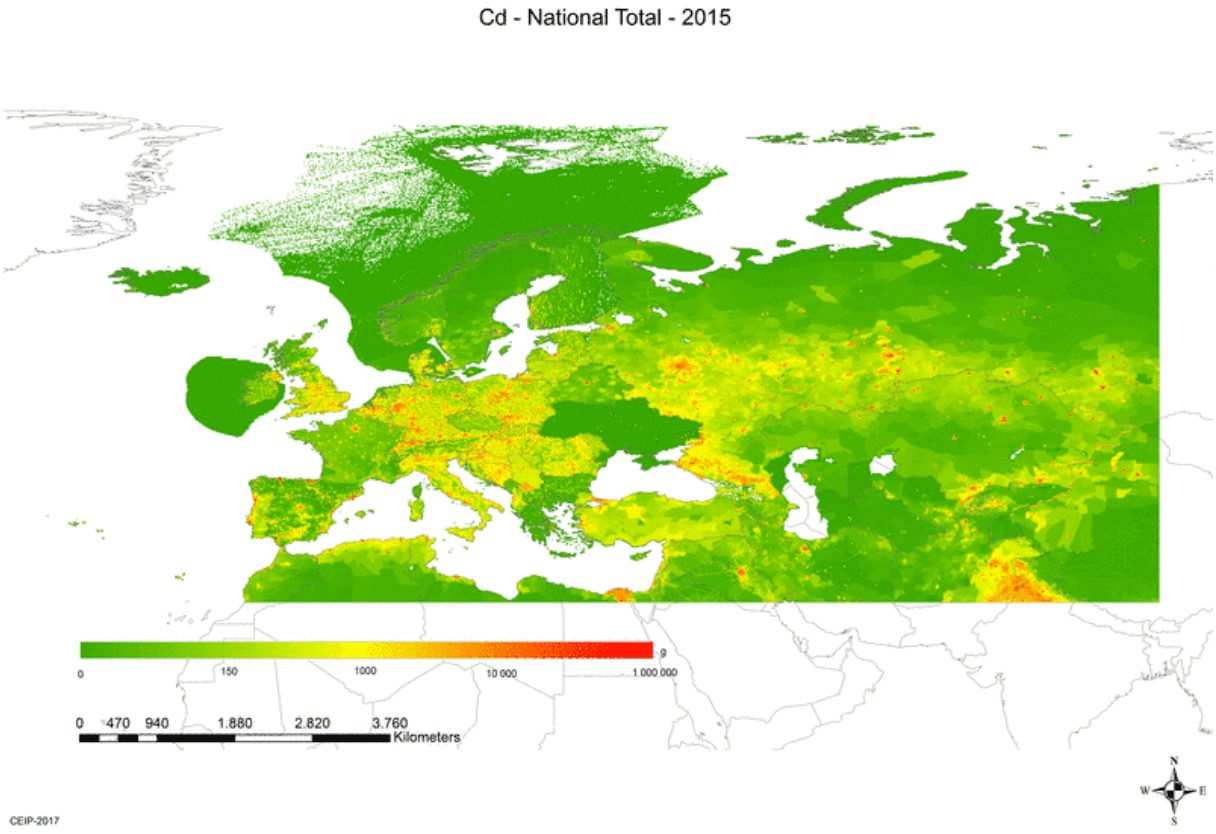
Figure 3.2 shows the sectoral distribution as reported and after gap-filling of Hg emissions in the year 2016 for all countries, as an example on the effects of the gap-filling.

Figure 3.2 Reported and gap-filled sectoral distributions of Hg emissions in the year 2016

4. Reasons for replacement of reported data

In cases, where data are in all probability erroneous, these data are replaced. If data in such cases will not be replaced, it is likely to get a wrong picture in gridded maps. As example, Figure 4.1 shows not replaced cadmium data of the Ukraine in gridded maps of the year 2015. In that case, the reported National Total was too low (compared with expert estimates and with the data of other countries), and showed an unusual sector distribution.

Figure 4.1 Example for too low National Total emissions and and unusual sector distribution of the Ukraine, showing a peculiar picture in gridded maps: Cadmium emissions of the year 2015



In 2018, data of three countries were replaced. **Fehler! Verweisquelle konnte nicht gefunden werden.** provides an overview of all replaced data of the gap-filled inventory 2018, including a short rationale. For more information see section **Fehler! Verweisquelle konnte nicht gefunden werden.**, information of the respective country.

Table 4.1 Overview of and reasons for replaced data

Country	Pollutant	NT, Sectors,…	Reason
AM	Pb	National Total, Sectors B + F	National total did not equal to the sum of sectors; strong discrepancy to expert data and reported data of other years. Incomplete sector reporting.
AM	Cd, Hg	National Total	Strong discrepancy to expert data and reported data of other years.
AM	Cd	Sector B	Incomplete sector reporting.

AM	Hg	Sectors A, B, C	Incomplete sector reporting.
KZT	Hg	National Total	National total did not equal to the sum of sectors; strong discrepancy to expert data.
KZT	Pb, Cd	National Total	Strong discrepancy to expert data.
KZT	Pb	Sectors B, F, G, J	Incomplete sector reporting.
KZT	Cd	Sectors B, G, I, J	Incomplete sector reporting.
KZT	Hg	Sectors B, E, G, J	Incomplete sector reporting.
UA	Pb, Cd, Hg	National Total, Sectors	Strong discrepancy to expert data.

5. Improvements of the gap-filling procedure

Most countries (29 of 51 countries) submitted data that seem to be complete and plausible. Problems occur especially where no data at all are available or when submitted data are not plausible.

In autumn 2017, a new tool was developed that simplify comparisons of emission data with other countries, expert data and previously reported and gap-filled data. Comparisons comprise National Totals, sector data, and data in relation to population and GDP data. This new tool was used for the gap-filling 2018.

6. Data availability and gap-filling method per country or area

6.1. Albania (AL)

In 2018, no submission was made. Reported data from previous years are available up to the year 2015, but for the years 2010 to 2015 only data of one single sector ("B – Industry") were reported.

The best method to calculate 2016 National Total data was extrapolation of 2000 and 2010 TNO data for cadmium and mercury, and interpolation of 2010 and 2020 TNO data for lead.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Georgia. Therefore the GNFR sector distribution from Georgia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.2. Armenia (AM)

In 2018, Armenia provided emission data for heavy metals, but only of a few sectors. Further, the sum of the sectors for lead did not equal to the National Total. The reported data differ strongly to expert estimates, to previous reported data and to the mean sector distribution from the 2017 gap-filled data set of all countries. Thus, reported data were replaced.

The best method to calculate 2016 National Total data for lead and mercury was the extrapolation of 2007 to 2014 emission data. For cadmium, extrapolation of 2007 reported data using population data was made.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Georgia. Therefore the GNFR sector distribution from Georgia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.3. Asian Areas (AST)

As this area consists of several countries and part of countries, no reported data are available. Emissions for this area have been estimated by MSC-E in 2013 for the year 2011. National Total emission data were copied from the estimations of the year 2011.

To calculate the sector distribution for the Asian Areas, the mean sector distribution from the 2017 gap-filled data set of all countries was used to split the sectors.

6.4. Austria (AT)

The data of Austria reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.5. Azerbaijan (AZ)

The data of Azerbaijan reported in 2017 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.6. Bosnia and Herzegovina (BA)

No reported data were available for Bosnia and Herzegovina. The best method to calculate 2016 National Total data for lead, cadmium and mercury was the extrapolation using 2010 TNO data and population data.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Serbia. Therefore the GNFR sector distribution from Serbia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.7. Belgium (BE)

The data of Belgium reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.8. Bulgaria (BG)

Bulgaria submitted data for the year 2016. No gap-filling was performed. The sector distribution of lead is rather unusual, with a large contribution of the sector “B - Industry”. Further review is recommended here.

6.9. Belarus (BY)

Belarus submitted data for the year 2016. No gap-filling was performed. Emission data are rather low compared with expert estimates. Further review is recommended here.

6.10. Switzerland (CH)

The data of Switzerland reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.11. Cyprus (CY)

Cyprus submitted data for the year 2016. No gap-filling was performed. The sector distribution of lead is rather unusual, with a large contribution of the sector “F – Road transport”. As well, the sector distribution of mercury is rather unusual, with a large contribution of the sector “B – Industry”. Further review is recommended here.

6.12. The Czech Republic (CZ)

The data of the Czech Republic reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.13. Germany (DE)

The data of Germany reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.14. Denmark (DK)

The data of Denmark reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.15. Estonia (EE)

Estonia submitted data for the year 2016. No gap-filling was performed. The sector distribution of lead and mercury is rather unusual, with a large contribution of the sector “A – Public electricity and heat production”. Further review is recommended here.

6.16. Spain (ES)

The data of Spain reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.17. Finland (FI)

The data of Finland reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.18. France (FR)

The data of France reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.19. The United Kingdom (GB)

The data of the United Kingdom reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.20. Georgia (GE)

Georgia submitted data for the year 2016. No gap-filling was performed. Emission data of mercury and especially of lead are rather low compared with expert estimates. Further review is recommended here.

6.21. Greece (GR)

In 2018, no submission was made by Greece. Reported data from previous years are available up to the year 2015. These data seemed to be complete and plausible. Therefore, sector data were extrapolated (years 2000-2015) and in doing so in all cases where extrapolation would have been resulted in negative values, the copy of the value for the year 2015 was used. The National Totals for lead, cadmium and mercury were then calculated by the sum of the sectors.

6.22. Croatia (HR)

The data of Croatia reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.23. Hungary (HU)

The data of Hungary reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.24. Ireland (IE)

The data of Ireland reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.25. Iceland (IS)

Iceland submitted data for the year 2016. No gap-filling was performed. The sector distribution of lead, cadmium and mercury is rather unusual, with a large contribution of the sector “J – Emissions from waste”. Further review is recommended here.

6.26. Italy (IT)

The data of Italy reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.27. Kyrgyzstan (KG)

In 2018, no submission was made. Reported data from previous years are available for the years 1999 (only lead), 2010-2012 and 2014-2015. However, not for all pollutants data are available, and only very few sector data are given. All reported data are much lower than the expert estimates, and due to the incomplete sector reporting the plausibility of the reported data is low.

The best method to gap-fill 2016 National Total data of lead was the interpolation of 2010 and 2020 TNO data. For mercury, extrapolation of 2000 and 2010 TNO data was done. Cadmium emissions are assumed to be proportional to the mercury emissions with a factor of 0.56 (information from MSC-E).

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Georgia. Therefore the GNFR sector distribution from Georgia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.28. Kazakhstan (KZT)

In 2018, Kazakhstan provided emission data for heavy metals, but only of a few sectors. Further, the sum of the sectors for mercury did not equal to the National Total. The reported data differ strongly to expert estimates and to the mean sector distribution from the 2017 gap-filled data set of all countries. Thus, reported data were replaced.

The reported 2016 National Total values were replaced by values interpolated from 2010 and 2020 TNO data for lead. For mercury, data from the year 2010 from the GMA were used for the year 2016. Cadmium emissions are assumed to be proportional to the mercury emissions with a factor of 0.56 (information from MSC-E).

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Poland. Therefore the GNFR sector distribution from Poland was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.29. Liechtenstein (LI)

In 2018, no submission was made by Liechtenstein. Reported data from previous years are available up to the year 2015. These data seemed to be complete and plausible. Therefore, sector data were extrapolated (years 2000-2015). The National Totals for lead, cadmium and mercury were then calculated by the sum of the sectors.

6.30. Lithuania (LT)

The data of Lithuania reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.31. Luxembourg (LU)

The data of Luxembourg reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.32. Latvia (LV)

The data of Latvia reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.33. Monaco (MC)

In 2018, no submission was made by Monaco. Reported data from previous years are available up to the year 2015. These data seemed to be complete and plausible. Therefore, sector data were extrapolated (years 2000-2015). The National Totals for lead, cadmium and mercury were then calculated by the sum of the sectors.

6.34. Republic of Moldova (MD)

In 2018, no submission was made by the Republic of Moldova. Reported data from previous years are available up to the year 2015. These data seemed to be complete and plausible. Therefore, sector data were extrapolated (years 2000-2015). The National Totals for lead, cadmium and mercury were then calculated by the sum of the sectors.

6.35. Montenegro (ME)

In 2018, no submission was made by Montenegro. Reported data from previous years are available up to the year 2011. These data seemed to be complete and plausible. Therefore, sector data for cadmium and mercury were extrapolated (years 2000-2011), and data for lead were copied from 2011, as there was a major change between the year 2011 and the years before. The National Totals for lead, cadmium and mercury were then calculated by the sum of the sectors.

6.36. The Former Yugoslav Republic of Macedonia (MK)

The data of the Former Yugoslav Republic of Macedonia reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.37. Malta (MT)

The data of Malta reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.38. The Netherlands (NL)

The data of the Netherlands reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.39. Norway (NO)

The data of Norway reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.40. North Africa (NOA)

As this area consists of several countries and part of countries, no reported data are available. Emissions for this area have been estimated by MSC-E in 2013 for the year 2011. National Total emission data were copied from the estimations for the year 2011.

To calculate the sector distribution for North Africa, the mean sector distribution from the 2017 gap-filled data set of all countries was used to split the sectors.

6.41. Poland (PL)

The data of Poland reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.42. Portugal (PT)

The data of Portugal reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.43. Russian Federation in the extended EMEP domain (RUE)

National Totals of lead, cadmium and mercury from the Russian Federation in the extended EMEP domain (RUE) were assessed using emission data for the Russian Federation in the former official EMEP domain (RU) by keeping the ratio between the two parts derived from the Global lead inventory. The factor is RU : RUE = 0.66 : 0.34.

For the Russian Federation in the extended EMEP domain a similar sector distribution as for the Russian Federation (in the former official EMEP domain) is assumed. Therefore, the sector distribution of RU is used to split the National Total emissions of RUE into the GNFR sectors.

6.44. Romania (RO)

The data of Romania reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.45. Serbia (RS)

The data of Serbia reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.46. Russian Federation in the former official EMEP domain (RU)

In 2018, no submission was made by the Russian Federation. Reported National Total data are available for 1990 to 2000, 2002 to 2006 and 2009. In the years 2002 to 2006 also data for the GNFR sector 'A_PublicPower' were reported, and for 2009 several sectoral data were available. The reported National Totals for the year 2009 are much lower than the trend of the years before. Sectoral data of the GNFR sector 'A_PublicPower', which is an important source sector for heavy metals, seems to be incomplete or too small for this year.

Sectoral data reported for 2009 were copied for the year 2016. Additional, data for the GNFR sector 'A_PublicPower' were extrapolated for 2016 from reported data of the years 2002 to 2006. National Total emission data for the year 2016 were then calculated by the sum of the GNFR sectors.

6.47. Sweden (SE)

The data of Sweden reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.48. Slovenia (SI)

The data of Slovenia reported for the year 2016 seemed to be complete and plausible. Therefore no gap-filling was performed.

6.49. Slovakia (SK)

Slovakia submitted data for the year 2016. No gap-filling was performed. The sector distribution of lead is rather unusual, with a large contribution of the sector "B - Industry". Further review is recommended here.

6.50. Tajikistan (TJ)

No reported data were available for Tajikistan. The best method to calculate 2016 National Total data was for lead to copy National Total emission data from the estimations made by MSC-E for the year 2011. For mercury, extrapolation of unpublished expert estimates using population data were used. Cadmium emissions are assumed to be proportional to the mercury emissions with a factor of 0.56 (information from MSC-E).

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Slovenia. Therefore the GNFR sector distribution from Slovenia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.51. Turkmenistan (TM)

No reported data were available for Turkmenistan. The best method to calculate 2016 National Total data was for lead to copy National Total emission data from the estimations made by MSC-E for the year 2011. For mercury, the extrapolation of two expert estimates was used. Cadmium emissions are assumed to be proportional to the mercury emissions with a factor of 0.56 (information from MSC-E).

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Slovenia. Therefore the GNFR sector distribution from Slovenia was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.52. Turkey (TR)

No reported data were available for Turkey. The best method to calculate 2016 National Total data was for cadmium the extrapolation of 2000 and 2010 TNO data, and for lead the interpolation of 2010 and 2020 TNO data. For mercury, data from the year 2010 from the GMA (AMAP/UNEP 2013) were used for the year 2016.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Poland. Therefore the GNFR sector distribution from Poland was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.53. Ukraine (UA)

In 2018, the Ukraine provided emission data for heavy metals. The reported data differ strongly to expert estimates, and to the mean sector distribution from the 2017 gap-filled data set of all countries. Reported data are similar to the data reported in 2017, and these data have been used for the gap-filled inventory in 2017 and led to some unusual pictures in gridded maps. Thus, reported data were replaced. For cadmium and mercury the extrapolation of 2000 and 2010 TNO data, and for lead the extrapolation of reported data using GDP data were used to fill the National Totals of the Ukraine.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Poland. Therefore the GNFR sector distribution from Poland was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

6.54. Uzbekistan (UZ)

No reported data were available for Turkmenistan. The best method to calculate 2016 National Total data for lead, cadmium and mercury was to copy emission estimates made by MSC-E for the year 2011.

To split the National Total emission data into GNFR sectoral emissions, the sector distribution of a similar country was used. The country that turned out as most similar (see section 3.2), and that also had a proper sector distribution, was Portugal. Therefore the GNFR sector distribution from Portugal was used to split the National Totals of Cd, Hg and Pb into GNFR sectors.

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8. EMEP Country Codes

AL	Albania
AM	Armenia
AST	Asian areas in the extended EMEP domain
AT	Austria
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BY	Belarus
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
EU	European Union
FI	Finland
FR	France
GB	United Kingdom
GE	Georgia
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IS	Iceland
IT	Italy
KG	Kyrgyzstan
KZT	Kazakhstan
LI	Liechtenstein
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
ME	Montenegro
MK	FYR of Macedonia
MT	Malta
NL	Netherlands
NO	Norway
NOA	North Africa
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
RU	Russian Federation in the former official EMEP domain
RUE	Russian Federation in the extended EMEP domain
SE	Sweden
SI	Slovenia
SK	Slovakia
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
UA	Ukraine
UZ	Uzbekistan

Table 8.1 Countries of the EMEP West and EMEP East region

EMEP West countries	AL, AT, BA, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LI, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK
EMEP East countries (9 EECCA countries + TR)	AM, AZ, BY, GE, KG, KZT, MD, RU, TR, UA
Non-EMEP EECCA countries (CLRTAP not ratified)	TJ, TM, UZ

Note: EECCA = Eastern Europe, Caucasus and Central Asia